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Brazil's Simplified Tax Regime and the longevity of Brazilian manufacturing companies: A survival analysis based on RAIS microdata☆

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Abstract

The article aims to analyze the effects of the Brazilian Simplified Tax Regime (*Simples Nacional*) on the longevity of manufacturing microenterprises, contributing to the current debate on the expansion of the program. Based on the RAIS (*Relação Anual de Informações Sociais*) microdata comprising the period between 2007–2013, a sample of manufacturing establishments, homogeneous in their economic structure, was selected and divided into two groups — those who opted for the program and those who did not. The Survival Analysis technique and the Propensity Score Matching made it possible to identify that the establishments opting for *Simples Nacional* that were created in 2007 had a 30% lower chance of mortality than the companies not opting for it. Another main result was the indication that separating manufacturing establishments by level of technology-intensiveness the Simplified Regime had a differentiated impact among the groups, with only the manufacturing establishments of low and medium-low technology-intensiveness sectors being affected.

JEL classifications: L20; C23; K34

Keywords: Brazilian Simplified Tax Regime; Tax policy; Industry; Survival Analysis; Propensity Score Matching

1. Introduction

Most countries in the Western world maintain some kind of differentiated tax treatment for micro, small and medium-sized companies (OECD, 2015). These programs aim to sustain levels of employment, promote the formalization of firms and to contribute to their longevity, especially of emerging companies.

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There is discussion worldwide on the effectiveness of these policies as to whether they actually increase the levels of economic growth, reducing poverty and/or strengthening the labor market. Despite the efforts made to provide evidence on this, there is still no consensus on their effects, especially in less developed countries (ILO, 2012).

Since 1997 Brazil has had a special tax regime for small businesses called the Simplified Tax Regime (*Simples Nacional*),[1] which reduces and simplifies the tax burden of micro and small enterprises — MSEs. Under the Simplified Regime, firms are able to collect up to six taxes through a single document,[2] by calculation and payment of a single rate applied to the company's gross revenue.

This regime unified the taxable amount, the date of payment, and the method of calculation of those six taxes. This has considerably reduced the cost and time spent by companies in complying with their tax obligations to the federal government. Monteiro (2004) estimates that the program has allowed an average reduction of up to 8 pp in the tax burden of MSEs. Along similar lines, Paes and Almeida (2009) show that companies opting for Simples Nacional have a tax burden estimated between 17 and 20% of revenues, while in other companies this percentage goes from 22.7% to 39.5%.

The amount owed by each company depends on range tables of annual gross revenue and on a list of types of economic activity. Until 2007, the simplified regime allowed only the collection of federal taxes, not including state and municipal taxes. Until then, there were five tax tables with revenue scales for each type of activity. There was one for retailing, another for industry and two for different types of services. Each table had nine revenue brackets with progressive rates: the higher the billing, the higher the total tax rate applicable. The rates varied from 3% to 5% of gross revenue for micro-enterprises (MEs) and from 5.4% to 7% for small companies. Only companies of certain economic segments with revenue below the limit could opt for the scheme. The limit was R$ 120,000 for micro-companies, and R$ 720,000 for small companies (Monteiro and Assunção, 2006).

Nowadays, the program represents the largest tax waiver by the Brazilian federal government — an estimated loss of R$ 72 billion in tax revenue in 2015 (Brazilian tax authority [*Receita Federal*], 2015). The Simplified Regime is adopted by more than 70% of MSEs in various segments of industry, retailing and services (Brazilian Planning and Taxation Institute — IBPT, 2015). Several studies show that among the simplified tax programs of different nations, Brazil's Simplified Regime is the most generous in terms of its income limit (Paes and Almeida, 2009; Appy, 2015). In the United States, for example, the ceiling on annual billing for inclusion in the favored regime is US$48,000; in Canada it is US$121,000; in the United Kingdom, US$114,000; and in Brazil, US$1 million. Even in comparison to emerging countries, the revenue limit of the Brazilian Simplified Regime is high: in Argentina it is US$48,000/year, in Colombia US$60,000/year and in Mexico US$148,000/year (Appy, 2015).

A recent survey with 2600 manufacturing entrepreneurs by the National Confederation of Industry (CNI) in 2015 reported that more than 70% of respondents disapproved of the national tax system, mainly because of problems associated with the large amount of taxes and their complexity. According to this study, these problems reduce the competitiveness of Brazilian industry — especially the high tax burden and the time spent on accessory tax obligations.

Dutra (2013) shows that for companies whose billing is close to this limit, growing will mean entering a tax regime that is disproportionately more expensive for small increases in annual revenue. The effect seems to be even greater for manufacturing companies than for commercial activities, partly because of the strong impact on sales margin of payroll and taxes in labor-intensive industries (Dutra, 2013).

This issue becomes even more important if we consider the current debate on expansion of the billing ceilings for the Simplified Tax Regime, as stated in the Draft Complementary Law (PLC) 125/2015,[3] which has been approved by

[1] The Integrated System for Payment of Taxes and Contributions for Micro- and Small Enterprises — *Sistema Integrado de Pagamento de Impostos e Contribuições das Microempresas e Empresas de Pequeno Porte* (the 'Simplified Tax Regime' — or 'Simples') was established in 1996 and underwent a major transformation in 2006, becoming the 'National Simplified Tax Regime', or 'Simples Nacional'.

[2] Corporate Income Tax (*IRPJ*), Social Integration Program (*PIS*) and Civil Servants Savings Fund (*Pasep*), Contribution to Finance Social Security (*Cofins*), Social Contribution on Net Profit (*CSLL*), Tax on Industrialized products (*IPI*), and Employers' Social Security Contribution (*CPP*).

[3] Draft Complementary Bill 125/2015 aims to avoid that companies be discouraged from growth by a disproportionate increase in their tax burden as they cross the maximum revenue threshold of the Simplified Tax Regime, by increasing the threshold limit, providing an update mechanism, and inclusion of a progressiveness within each revenue range, and a deductible portion on the lines applied to income tax of private individuals (CNI, 2016).

the lower house of Brazil's Congress and is currently awaiting the polling in the Senate. One of the main changes in the draft bill is to increase the billing ceiling from R$ 3.6 million/year to R$ 4.8 million/year.[4]

According to the CNI's Legislative Agenda for Industry 2016, this draft law is one of the most important proposals being made for the Brazilian manufacturing sector in 2016, since it could significantly change the rules for companies that have adopted the Simplified Regime in terms of exclusion from it and facilitating both exports and the payments of tax liabilities by installments (CNI, 2016). By increasing the revenue limit, the reform would also increase the government's tax waiver associated with the Simplified Regime (Receita Federal, 2015).[5]

In spite of the economic importance of Simplified Tax Regimes in general, and the Brazilian program's almost twenty years of existence, there are few studies evaluating it in the Brazilian economic literature, especially its effect on company mortality rates. The evidence available on the effect of the program on a wide range of economic variables does not provide a consensual position on, for example, the effectiveness of the Brazilian Simplified Regime in terms of causing companies to adopt formal organization or in terms of job creation.

The work of Delgado et al. (2007), based on a longitudinal study using microdata of companies opting for the Regime, raises doubts as to the Regime's ability to induce creation of new jobs by those companies, since it found that companies that had not opted for the Regime presented superior performance in four out of five analyzed measures. Along similar lines, Piza (2016) calls into question the validity of some studies that had demonstrated the effectiveness of the Simplified Regime in inducing new companies to adopt formal organization, such as those of Monteiro and Assunção (2006) and Fajnzylber et al. (2009).

This being so, the evidence that was available until that time now appears perhaps less reliable, creating scope for further investigation. This paper seeks to fill a gap in the literature on the effects of the Brazilian Simplified Regime in terms of the longevity of Brazilian companies. It focuses on micro-scale manufacturing companies of the Brazilian state of Rio Grande do Sul, in sectors that are eligible for the program, and which started operating in 2007. The paper's aim is to analyze the impact of the Simplified Regime on the survival rate of two groups of establishments set up in that year: those that opted for the Regime and those that did not. The paper also tests the hypothesis that the Regime has the same effect on manufacturing companies with different levels of technology-intensiveness (low, medium-low, medium-high and high).

For this purpose, Survival Analysis technique was applied to a cohort of 3187 establishments that are included in the microdata of the Relação Anual de Informações Sociais [RAIS, Ministry of Labour, Brazil] system between 2007 and 2013, separated into two groups: on the one hand, those who opted for the Simplified Regime since the beginning of their activities and on the other, those who have not opted for the program since the beginning of the analysis, even though operating in segments eligible for the program (the 'control group'). In both cases, we considered only establishments that did not change from opting to not opting (or vice versa) over that period. Prior to the longitudinal monitoring, the Propensity Score Matching (PSM) tool was used to select groups of establishments that were most similar in their economic structure at the initial moment of analysis. Only those beneficiary establishments that had a sufficiently similar counterpart in the control group were included in the analysis.

The remainder of the paper is organized as follows. Section 2 presents the main characteristics of the Brazilian Simplified Tax Regime, commenting on how it has changed over time and on its structuring. Section 3 presents a review of the empirical literature on the Survival Analysis and the Simplified Regime in Brazil. Section 4 describes the empirical strategy and the database. Section 5 presents the characteristics of the sample establishments and the Survival Analysis results. Section 6 discusses the final considerations.

2. The Brazilian Simplified Tax Regime and its structuring

When Brazil's Simplified Tax Regime (officially, the Integrated System for Payment of Taxes and Contributions by Micro- and Small Enterprises — *Sistema Integrado de Pagamento de Impostos e Contribuições das Microempresas e Empresas de Pequeno Porte*, *or* 'SIMPLES') was instituted in 1996, it represented a notable change in the Brazilian

[4] Originally, the draft law included increase of the revenue ceiling from the current R$ 3.6 million/year to R$ 14.4 million/year, for industry, and R$ 7.2 million/year, for trade and services.

[5] A recent report by the Brazilian Federal Revenue Service (*Receita Federal*, 2015) states that with the expansion of the revenue limit threshold of the Simplified Regime, proposed in Draft Complementary Law 125/2015, the tax weaver, which in 2015 was of R$ 72 billion, could increase at the rate of R$ 11 billion per year, as more establishments joined the Regime and stayed in it.

legal system. It was conceived as an economic incentive to induce formalization of firms and jobs and as a way of consolidating the various tax benefits received by micro and small companies at the time, reducing the number of informal organizations and promoting employment in small companies.

The largest modification of the Simplified Tax Regime took place in 2006 with Complementary Law 123/06, which included in the regime: (a) a tax charged by the subnational governments – the ICMS value-added tax (*Imposto sobre Operações Relativas à Circulação de Mercadorias e sobre Prestações de Serviços de Transporte Interestadual e Intermunicipal e de* Comunicação – the 'Tax on Circulation of Goods and on Interstate and Intermunicipal Transport and Communication Services') – and (b) a tax collected by municipalities – the ISS Tax on Services (*Imposto Sobre Serviços de Qualquer Natureza* or *ISSQN*). This transformed the Simplified System into a shared regime of collection and inspection of taxes at all the three levels of government, turning it into the 'Unified Special Regime for Collection of Taxes and Contributions owed by Micro and Small Companies' (*Regime Especial Unificado de Arrecadação de Tributos e Contribuições devidos pelas Microempresas e Empresas de Pequeno Porte*, renamed '*Simples Nacional*' or National Simplified System.

The 'National' Simplified System came into effect in July 2007, and all companies who had opted for the original federal-only Simplified System were automatically included in the new one. The main innovations brought in by Complementary Law 123/06 were: shared system management, inclusion of new eligible activities, updating of the billing ceilings, and an increased level of tax waiver by the federal government. As from 2007 the Simplified Regime was jointly managed by the municipalities, the states and the federal government, through the National Simplified System Steering Committee (*Comitê Gestor do Simples Nacional*, or CGSN). This committee has powers to decide which sectors are eligible for inclusion, or exclusion; the billing ceilings; and all other operational issues.

Further changes were made to the National Simplified System in 2014 by Complementary Law 147/2014, which created a new rate scale and included a significant number of new activities, notably in services which were subject to this new table. Previous exclusions of certain economic segments were significantly altered. The system has now six tax rate scales, with 20 revenue levels, covering a wide range of economic activities in retailing, manufacturing and services.

3. Literature review

3.1. Literature on Survival Analysis

The knowledge about the survival level of Brazilian companies is very limited and we found no studies looking at the direct effect of the Simplified Regime on the longevity of companies in the literature. Most of the studies on mortality of companies are from other countries and are based on administrative data maintained by governments. Survival Analysis is a traditional approach in the international economic literature for evaluating the mortality of companies and their determinants, but is still rarely used in Brazil for this purpose.

In general, firm survival studies analysis focuses on the company's internal factors, such as age, size, business sector and degree of investment in R&D. This is the case of the works of Audretsch (1991), Audretsch and Mahmood (1995), Mata and Portugal (1994), Van Praag (2003), Helmers and Rogers (2010) and Nulsch (2014). Empirical evidence suggests that emerging companies are at a greater risk of closure (Stinchcombe, 1965; Freeman et al., 1983; Bruderl and Schussler, 1990) and that the smaller the size of the firm at birth, the lower its longevity.

In addition, the literature indicates that mortality varies significantly between different sectors of economic activity in the same country (Audretsch et al., 1998; Bartelsman et al., 2005). Recent studies have been showing that the level of investment in R&D and the fact that a firm is an exporter are associated with a greater propensity to survive (Agarwal and Audretsch, 2001; Cefis and Marsili, 2005; Máñez et al., 2015; Dzhumashev et al., 2016; Ugur et al., 2016).

The work of Giovannetti et al. (2017) represents another strand of literature, focused on the survival relation between companies that have branches versus those that do not. The authors have analyzed how the characteristics of companies affect the business' demographic dynamics. The authors calculated the probability of survival of affiliated companies according to the characteristics of the companies themselves and the parent company in terms of size and technology. Their results show that affiliates of large companies are more competitive and survive longer. They also discovered that belonging to a network of affiliates increases the company's survival probability. Another finding is that when the parent company has a higher (lower) level of technology than the affiliated companies, their failure probability increases (decreases).

Other studies have focused on the relationship between macroeconomic conditions and corporate longevity, such as the role of the country's institutional quality and the influence of business cycles on firms' survival. Kelly et al. (2015), for example, analyze the role of credit and macroeconomic conditions in the survival of small and medium-sized companies. The study uses information from companies in Ireland that made bank and non-bank loans during the financial crisis that began in 2007/2008. Controlling for location and economic sector, their results confirm that the long-term macroeconomic conditions, given by stock variables, such as the unemployment rate and the availability of credit throughout the economic cycle, are more relevant to explain the companies' survival than flow variables, such as changes in GDP, which capture only short-term fluctuations. The authors have also found that companies that were born in periods of high economic growth (economic boom), when subject to adverse conditions in the macroeconomic environment or in the availability of credit, are more likely to become insolvent than companies born in a restrictive environment. Che et al. (2017), using data from manufacturing companies in China from the 1998–2005 period, found that institutional quality has a significant and positive impact on the longevity of private companies. According to their estimates, a one-standard-deviation increase in the security of property rights protection (as proxy for institutional quality) leads to an 8.8% decrease in the hazard rate of private companies.

With regard to Brazil, the literature on Survival Analysis is still incipient, considering that most studies are from the last five years. One of the main studies on the subject in Brazil, SEBRAE (2013), shows that small manufacturing companies have the highest survival rates — corroborating the work of Najberg et al. (2000) and IBGE (2013). Among the reasons for this are the higher entry (and exit) barriers and less pressure from competition in manufacturing activities than in retailing, services and construction (Carvalho and Cerqueira, 2010). Resende et al. (2016) use RAIS data to analyze the determinants of survival of industrial establishments born in 1996 and monitored in the period between 1996 and 2005, considering only small companies (up to 250 employees). The Kaplan–Meier estimates show that the survival rate after three years is 50%, which reveals the low longevity of emerging companies in the country. The results of the Cox regression model indicate that firm size as well as the size of the sector and its growth are significant elements to explain the mortality of small firms.

An important reference for our study is the work of Coelho et al. (2017). The authors also use the RAIS to analyze the dynamics of jobs in Brazilian firms in the period between 1993 and 2013. The authors show that before they effectively disappear from the formal records, the establishments undergo an adjustment process in the number of employees, progressively reducing them until the establishment closes. In addition, the results reinforce the high mortality prevalent among small emerging companies in their early years. The study estimates the mortality rate by age of the establishment and reveals that the highest risk of death occurs in the second year of life (12.8%), followed by the third (9.7%) and the first year (6.9%). After the third year, the rate drops to reach 4.3% in the twelfth year of life. The authors conclude that, due to this dynamics observed for the mortality and employment of firms, there is a *missing middle* in the distribution of company size in Brazil. That is to say that there is a distribution with high concentration of establishments of very small size, on the one hand, and of very large companies, on the other, with the portion destined to medium-sized companies with very limited participation in the total of companies. Coelho et al. (2017) attribute this to factors such as programs to support micro and small enterprises, including the 'Simplified Regime' and conclude affirming that 'Unfortunately, the effectiveness of these interventions has not been assessed, it is difficult to say whether and to what extent they have actually affected the performance of micro and small establishments in the country' (Coelho et al., 2017, p. 19).

3.2. The literature on the Brazilian Simplified Tax Regime

One of the first studies to address the effect of the Simplified Regime on the Brazilian economy was that of Cechin and Fernandes (2000), which showed a considerable increase in the number of formal employment relationships declared – in their FGTS and Social Security Payment Slips (GFIPs) – by companies that had opted for the Simplified System in comparison to non-adopters in the years following the start of the program: in the period from January 1999 to March 2000, the number of formal employment relationships increased by 20% for establishments that opted for the Simplified System, and decreased by 2% among those that did not.

Viol and Rodrigues (2000) pointed out that the main reason for this behavior seems to be related to the tax incentive that the Simplified System provides by disconnecting the figures for salary and number of employees from the tax calculation: the change in the basis for calculation of the Employer's Social Security Contribution (*Contribuição Previdenciária Patronal*, or CPP) for companies opting for the Simplified regime allowed them to have the same CPP

cost regardless of the number of employees — while for those not opting for the regime, salary and the number of registered employees did affect the total CPP payable.

Monteiro and Assunção (2006), using a rich database of information on small informal businesses, 'Informal Urban Economy 1997', sought to identify the effect of the Brazilian Simplified Regime on another important economic variable: the rate of formalization of companies that came into being in 1996 and 1997. Even though this was a cross-sectional database, the authors were able to identify companies that had been in existence only for a few months, and analyze them in relation to the information collected by the study, comparing the companies that were eligible for the Regime with a group of non-eligible companies. The main result arising from application of different treatment effect models (difference-in-differences, PSM and instrumental variables) is a 13 percentage-point increase in the proportion of retail companies using the Simplified Regime that were formally registered, due to the legislative 'shock' represented by the Simplified Regime. For the other sectors – industry, construction and services – no change in the percentage of formalization was found to have resulted from the program among companies set up immediately after the introduction of the Simplified Regime.

The work of Delgado et al. (2007) presents contradictory evidence on the impact of the Simplified Regime on the domestic economy: on the one hand, the program seems to have contributed to the creation of new establishments, but on the other hand it may not have been effective in causing creation of new jobs among companies opting for it. Based on the GFIP and RAIS macro-data, the authors found that the total number of establishments adopting the Simplified Regime grew by a substantially higher percentage – 40% – over the years 2000–2005 than those presented by the non-adopters, which was 4.1%. In absolute numbers, approximately 500,000 new establishments were created in the period, predominantly small (up to nine employees), stimulated, to some extent, by the change represented by the Simplified Regime.

To determine whether the Simplified Regime helped to strengthen the Brazilian labor market, the authors followed a group of 4000 service sector establishments that joined the Simplified Regime between 2000 and 2005, based on GFIP microdata. Four performance indicators were analyzed: the number of employees, the average salary, the number of self-employed workers, these workers' payment and the totals of social security contributions paid. In all these measures, establishments not adopting the Simplified Regime grew faster than adopters, with the exception of the variable *average remuneration of self-employed workers*. This could suggest that even in the absence of the program new jobs would still be created. Considering the longitudinal nature of this study, and its relevance, these results raise doubts as to the ability of the Simplified Regime to create jobs in the Brazilian economy.

The findings of Fajnzylber et al. (2009) corroborate the position of Monteiro and Assunção (2006) on the positive effect of the Simplified Regime on formalization of microenterprises created after the Regime came into effect. Using the data from the same study used by Monteiro and Assunção (2006), the authors found a considerable increase in the percentage of establishments that were formally registered (using the numbers of physical-operation licenses ('*alvará*s') issued by prefectures as a proxy for the number of formally registered operations) after introduction of the Regime: this percentage increased from 30% of all companies with at least one employee, in 1997, to 49% in 2003. The results of the treatment effect models used in the analysis (Regression Discontinuity Design and differences-in-differences) also suggest that, when divided into those eligible and those not eligible for the Simplified Regime, according to their sector of activity, the formal companies created in this period performed better than their informal counterparts. Unfortunately, the authors did not address sector differences that might indicate some effect on the industry and thus compare the results with the prior literature.

Piza (2016) made a critical review of the work of Fajnzylber et al. (2009) and Monteiro and Assunção (2006), aiming to test the validity of the identification strategies used by the authors to determine the impact of the Simplified Regime on formalization. Replicating the authors' article, Piza (2016) – applying robustness tests and control groups with placebo treatment – noticed that the results of previous studies did not prove to be persistent to sensitivity tests. Thus, it appears that the most recent evidence challenges the prior position on the effectiveness of the Simplified Regime in stimulating formalization of informal companies.

3.3. The Simplified Regime and the Brazilian Manufacturing Industry

There are few works in the economic literature on the impact of the Simplified Regime on Brazilian manufacturing industry, so this is still a new and less established area of research. The pioneering work apparently was that of Caetano (2010), who observed the effects of the program on the manufacturing industry of the state of Ceará over the period

1996–2008 — the period from one year before the Federal Simplified Regime first came into effect until one year after the three-level National Simplified Regime came into effect.

Using micro and small enterprises (MSEs) as the 'treatment' group and medium- and large-scale companies as control group, the author studied two outcome variables: the number of establishments and the volume of employment in the industry. Application of the difference-in-differences approach indicated that the Simplified Tax Regime had a positive effect on those two variables, which was more marked in the Metropolitan Region of Fortaleza, where a large part of the jobs and companies created were located. Caetano (2010) attributes this to wage and schooling differentials between the Metropolitan Region of Fortaleza and cities in the rest of the state and also to locational aspects that attract firms to the capital cities.

One of the main studies in this area is Corseuil and Moura (2011). The authors followed approximately 3500 manufacturing companies of the Annual Industry Survey (*PIA*) over 1997–99, divided into two groups: on the one hand, companies that had opted for the Simplified Regime and had revenue close to but slightly below the revenue ceiling; and on the other hand, companies that had not opted for the Regime and had revenue slightly above the ceiling.

Through the Regression Discontinuity technique, the authors observed that average employment evolved in a very similar way in the two cohorts — which could suggest that the program did not contribute to the generation of employment in the sector. What the study really indicates, however, is that average employment tends to fall among companies that opted for the Simplified Regime because the program may have prevented the closure of establishments and also contributed to the growth in the number of formal employment relationships — so that the two effects cancel each other out in measuring the variable 'average employment'.

Due to the sample used in the Annual Industry Survey, these results are valid only for the universe of manufacturing companies with more than 30 employees, and therefore applicable only to small, medium and large companies – leaving out the micro-companies (those with up to nineteen employees) – as measured by the size criterion of number of employees of Sebrae [*Brazilian Micro and Small Business Support Service*], (2015). In spite of the limitations of the research, the results point to important implications of the Simplified Regime for the Brazilian manufacturing sector as a whole.

Finally, Franco (2016) provides recent evidence corroborating the findings of the literature on the effect of the Simplified Regime on job creation, and also a result that seems to contradict it on wages. Using the same database (PIA) as Corseuil and Moura (2011) and a similar identification strategy (RDD), for the period from 2007 to 2012, the author found that companies with billing close to the ceiling of the Simplified Regime showed a 21% higher increase in total number of employees than non-opting companies in the same billing range. The same was seen in personnel linked to production: a 23% increase for those opting for the Regime.

Notwithstanding what was observed by Delgado et al. (2007), the author also observes a greater increase in the variables *salary* and *total employed* among those opting for the Simplified Regime: 25% and 26%, respectively. The author's estimates also show that the program appears to have reduced the operating cost of companies close to the billing ceiling by approximately 9% compared to those in the average billing range. Franco (2016) points out that the findings are robust to different tests of falsification and sensitivity and concludes that the increase of employment and wages can be attributed largely to the reduction of the industry's operating cost.

The results discussed in this section highlight the importance of the Simplified Regime for Brazilian industry, especially considering that the regime was found to be effective on employment in both phases of the Simplified Regime. The available evidence, however, does not account for the effect of the program on the longevity of manufacturing microenterprises, which is the subject of this paper.

4. Methodology

4.1. Empirical strategy

This work uses two different econometric techniques to analyze the survival of manufacturing companies — Propensity Score Matching and Survival Analysis. The sample selected was 3187 new manufacturing establishments created in 2007 with up to nineteen employees (i.e. micro-enterprises) and tax domicile in the state of Rio Grande do Sul. The choice of location, sector and size was due to the availability of the data obtained — noting that manufacturing companies are more numerous than extractive activities in the universe of companies opting for the Simplified Regime in Rio Grande do Sul (Receita Federal, 2016).

The year 2007 was chosen due to its being the first year of the 'National' Simplified Regime, on the basis that the effects of the previous regime (which applied only to federal taxes) would no longer be present. The aim of this separation was to avoid a possible contamination by the effects of the previous Regime.

The choice of size aimed to fill the gap in the literature relating to the effects of the Simplified Regime on longevity of microcompanies in manufacturing industry, and follows the methodology used by SEBRAE (2015). Micro-companies are classified as those with up to nineteen people working.

The first step was to identify the beneficiary group and the control group. Since the Regime reduces companies' tax burden, it is considered as an intervention in favor of the establishments opting for it. Thus, (i) the beneficiary group was establishments opting for the program; and (ii) the control group consisted of companies eligible but not adopting the Regime. Eligibility was established using the list of codes for non-qualifying and ambiguous activities for the first year of the Regime, as stated in Appendix I to Resolution 6 of the Simplified Regime Steering Committee, of June 18, 2007—using the National Economic Activities Classification (CNAE) version 2.0.

With the paired sample, the next step was the use of Survival Analysis, initially based on choice to adopt or not adopt the Regime and then the same groups with breakdown by level of technology intensiveness — this second step being intended to assess any differentiated effects of the Regime among sectors of manufacturing industry.

Several studies have shown that segments of manufacturing industry differ by: the importance of technological changes, capital-intensiveness, sunk costs, average size, and degree of market concentration.[6] For the categorization by level of technology-intensiveness, this paper uses the taxonomy proposed by Cavalcante (2014),[7] available at Table A1 in the Appendix A.

4.1.1. Propensity Score Matching

This technique ('PSM') was used to reduce a possible selection bias related to opting for the Regime and thus to increase the comparability between the establishments that opted in and those that did not.[8] With the beneficiary and control groups decided, the probability of each establishment of the sample participating in the program based on its observable characteristics was calculated.

PSM uses the values associated with the variables that make up the covariates vector of the analysis to calculate the probability of each establishment participating in the Regime. These estimated probabilities are called propensity scores and are traditionally calculated by parametric methods, such as probit or logit.

Once the propensity scores were obtained, the individuals treated were paired with the individuals not treated on the basis of these probabilities, according to the kernel matching algorithm. In this work, the PSM made it possible to obtain a sample composed only of establishments similar to each other at the initial moment of the analysis. These totaled 3187 observations.

The area of common support was found to be formed by establishments with probability of adoption ranging from 11% to 90%.[9] In this paper, PSM was used to keep in the sample only observations that were similar to each other, i.e. the observations that were within the region of common support — without aiming to compute the average treatment effect on the treated (ATT).

4.1.2. Survival Analysis

In this work, the event of interest is the death of the establishment and the time until the event occurs[10] — which is the dependent variable of Survival Analysis. In this context, survival time, t, can be considered a continuous and

[6] For more on this subject please see Furtado and Carvalho (2005), Galeano and Wanderley (2013) and IBGE (2013).

[7] The author adapted to Brazil the two technological classifications most widely used in the world for this purpose: Pavitt's taxonomy and the OECD classification.

[8] For a detailed explanation of the workings of PSM, see Caliendo and Kopeinig (2008).

[9] For reasons of space, the pairing results have not been presented. However, they are available and can be requested from the authors.

[10] For this analysis, the events of birth and death of an establishment are considered to be the establishment's appearance on, and disappearance from, the RAIS list of employing establishments for the period under study.

positive random variable with probability distribution F (t) and probability density function f (t) in which T is the maximum time for t ($t \leq T$):

$$f(t) = \lim_{\Delta t \to 0^+} \frac{Pr(t \leq T \leq t + \Delta t)}{\Delta t} \tag{1}$$

$$F(t) = Pr(T \leq t) \tag{2}$$

The survival function, in turn, is denoted by $S(t)$ — being defined as the probability of an observation not failing until time t, formally:

$$S(t) = Pr(T > t) = 1 - F(t) \tag{3}$$

The survival function S(t) is contained in the interval between 0 and 1 ($0 \leq S(t) \leq 1$) and is usually obtained using the Kaplan–Meier nonparametric estimator (Kaplan and Meier, 1958). This estimator considers all periods in which the event takes place as $t_{(j)}$ such that $t_{(1)} \leq t_{(2)} \ldots \leq t_{(3)}$ and is calculated as follows:

$$\hat{S}(t)_{KM} = \prod_{j:t_j<t} \left(1 - \frac{d_j}{n_j}\right) \tag{4}$$

— where $\boldsymbol{d_{(j)}}$ is the number of subjects that experienced the event in time $\boldsymbol{t_{(j)}}$ and $\boldsymbol{n_j}$ is the number of individuals who have not yet experienced the event. The multiplicand is the presentation of all failures in a period shorter than or equal to t.

When the analysis is conducted for only one group, it examines the cumulative survival curve, which shows the probability of survival after the end of each period for the entire sample. In the presence of more than one group, it is possible to calculate different survival curves for each group and to test the hypothesis of equality between them. The Log-rank and Wilcoxon tests (Kleinbaum and Klein, 2012) are usually employed for this purpose.

The counterpart of the survival function is the *hazard function* — expressed by $h(t)$. This function is the instantaneous failure rate, which is the probability of an individual undergoing the event in a time interval from t to $(t + \Delta t)$, given that it has not yet occurred, and can be represented as:

$$h(t) = \frac{f(t)}{S(t)} \tag{5}$$

$$h(t) = \lim_{\Delta t \to 0} \frac{Pr(t < T < t + \Delta t | T \geq t)}{\Delta t} \tag{6}$$

In this study, the purpose of survival analysis is to estimate the rate of risk of an establishment undergoing the event '*closure*', as well as the factors that may contribute to the occurrence of that event. One of the most widely used estimators for this purpose is the model of Cox proportional hazards, which calculates the risk function for an individual i as (Cox, 1972):

$$h_i(t) = h_0(t) \exp(\beta' x_i) \tag{7}$$

where $\beta' x_i$ is a vector px1 of unknown parameters, $h_i(t)$ is an unknown function of risk rate, called baseline function, and $\beta' x_i$ is a known function, it being usual to use the exponential distribution. This model is semi-parametric because it has in its composition the function $\beta' x_i$, which assumes a parametric distribution and the baseline function, estimated non-parametrically.

The model's main assumption is the proportionality of risk among individuals of which the ratio is constant over time. Thus, the risk of any individual i is a multiple of the risk of any other individual j and the factor $e^{\beta.(x_1 - x_2)}$ is the risk ratio — where $\boldsymbol{x}_1$ is an individual who does not participate in the program and $\boldsymbol{x}_2$ is one who participates in it. To validate the appropriateness of the model, it is necessary to test the proportional hazards hypothesis, which can be done by a graphical approach or by the Schoenfeld Residuals Test (1982).[11]

[11] For more information about statistical tests and other validation methods, see Kleinbaum and Klein (2012).

Table 1
Description of variables.

Variable	Description
Adopter	Binary variable that takes value 1 if the establishment has opted for the Simplified Tax Regime and 0 if not.
formal_emps	Integer variable: number of workers with active employment link on December 31 of each year, under the CLT[a] regime and with non-limited time contract.
avge_salary	Continuous variable: average remuneration for the month of December of all active workers at December 31 of each year, in nominal value (R$).
time_empl	Continuous variable: average time (months) of formally registered employment (CLT) of all active workers at Dec. 31 each year.
total_sals	Continuous variable: sum of salaries for December of all workers with active formal employment on Dec. 31 of each year, in nominal value (R$).
contr_hrs	Continuous variable: sum of contractual hours of all formally registered employees on Dec. 31 of each year.
low	Binary variable: 1 if technology-intensiveness of establishment considered 'low', 0 otherwise.
med-low	Binary: 1 if technology-intensiveness of establishment considered 'medium', 0 otherwise.
med-high	Binary: 1 if technology-intensiveness of establishment considered 'medium-high', 0 otherwise.
high	Binary: 1 if technology-intensiveness of establishment considered 'high', 0 otherwise.

Source: RAIS, 2007–2013 (Microdata). Compilation: author.
[a] CLT stands for Consolidated Labor Laws (a specific system of labor laws), a code of labor laws enacted by Decree-Law n. 5462, from May 1, 1943.

4.2. Database and variables

The variables used are described in Table 1 and are sourced from the microdata of the Annual Social Information Report (*RAIS*) for the period 2007–2013. The RAIS, established in 1975 by Decree 76900, is a Ministry of Labor administrative record that gathers annual socio-economic information on employees and employers.

The RAIS database is compiled from data sent to the Brazilian Ministry of Labor by companies and employers with information on employees (compensation, occupation, age, sex, gender) and establishments (sector of activity, size, legal, whether or not adopted the Simplified Tax Regime). For this paper, we retained in the database only establishments with at least one formally registered employee active link on December 31 of each year. In the analysis we considered only registered employees still active on that date — i.e. excluding any employees who had left during the year.

Since the objective of this study is to investigate the effects of the Simplified Regime on companies' longevity, it was decided to select establishments that were created in the first year in which the National Simplified Regime came into effect (2007), of eligible sectors to the program and those that, once they have opted or not for the Regime, remained with no change of status until the end of the period. Only 14.7% of the sample were establishments that changed their option on the Simplified Regime over the analyzed period. In Section 5, some robustness checks are presented considering the establishments that were excluded from the final sample because they have changed their status as to the Simplified Regime during the period.

This limitation as to option was used because the Survival Analysis technique requires information on whether the subject observed was treated or not over the period of the study; if we were to include opting establishments later, the same establishment could be included in one group at one time and not at another, distorting the results of the analysis.

Thus, the only establishments that were included in the study were those that had opted for the Regime since the moment they were created,[12] and those that did not opt for the Regime at any time during the whole of the period investigated.

For the sake of simplicity, establishments that were born in 2007, died in some of the years between 2007–2013 and reappeared over the remaining period were excluded from the analysis. We assume this hypothesis because the Survival Analysis technique looks at the event of extinction of the company in such a way that it cannot take place more than once in the period.

[12] In this work establishments created in 2007 are taken to be those with at least one employee who did not appear in the RAIS in 2006, but appear in the RAIS in 2007.

Table 2
Percentage of companies in each category of technology intensiveness that opted for the Simplified Tax Regime.

	Low	Medium-Low	Medium-High	High	Whole sample
% of companies in the category that opted for the Regime	74.70	75.00	57.07	53.66	73.48

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.
Note: Classification of activities is by Cavalcante (2014).

5. Results

5.1. Overview of data[13]

Table 2 shows the percentages of companies in each category of technology intensiveness that opted for the Simplified Regime: the categories are Low, Medium-Low, Medium-High and High. Note that, of the establishments created in 2007, in sectors that were eligible for the Simplified Regime, with up to 19 employees, the percentage of companies opting to adopt the regime is high (73.48%) — which is logical, as it brings advantages in terms of tax burden for the manufacturing sector.

Among the groups, with their varying levels of technology intensiveness, a majority opted for the Simplified Tax Regime and the categories Low and Medium-Low had high percentages: 74.7% and 75% respectively. The lower percentages for Medium-High and High are in part attributed to the nature of these activities, which usually call for high investment in terms of capital and specialized staff and are thus less likely to be operated by micro- or small companies that are eligible for the Simplified Regime.

Table 3 shows the distribution of the 3187 establishments of the sample sorted by main economic activity. As can be seen, it is heterogeneous — the following being predominant: manufacture of food products (CNAE code 10); production of apparel items (CNAE code 14); treatment of leather, and shoe manufacturing (CNAE code 15); and manufacture of metal products other than machinery and equipment (CNAE code 25). These activities constitute the sectors with Low and Medium-Low technological density.

Table 4 below shows the changes in the average of certain selected variables for establishments that adopted the Regime and those that did not over the period. Before analyzing the changes of the variables over time it is appropriate to note that, in general, those not adopting the Regime have more employees, greater durability of employment relationships and also higher levels of average salary — which is an stylized fact of the demography of companies in Brazil according to the economic literature on the Simplified Regime. Traditionally, establishments not adopting the regime are larger and more developed, so that they often cannot become taxpayers under the Simplified Regime.

It can be seen that in two of the three analyzed variables those adopting the regime showed better performance than those not adopting it in number of employees (*formal_emps*) and in average time of employment relationships durability (*temp_empl*). The exception is average salary, which increased more among the non-adopter companies.

The growth of the number of employees over the period 2007–2013 was almost the double among those adopting the Regime: 45%, versus 24% for the non-adopters. In the period, the average time of employment relationship increased by around 210% in those adopting the regime and by 81% in those not adopting it. The total salaries of those adopting the Regime also grew faster (192%) among those adopting the Regime than among those not adopting it (146%). Finally, in contrast to the other indicators, employees' average salary in the establishments adopting the Regime grew by 98%, less than the growth shown in those not adopting the Regime (109%).

The evidence of Table 4 indicates that companies opting for the Regime appear to have employed more employees and also to have had lower turnover than those not opting for the regime during the period in which they were under it, which is an important result for discussion of the program as an instrument for preservation of manufacturing micro-companies. These results support the position of Corseuil and Moura (2011) on the contribution that the Simplified Regime makes to the longevity of small businesses and demonstrate that average employment grew at a higher rate among companies opting for the Regime.

[13] In this section, the terms Simplified Regime or Regime are used interchangeably.

Table 3
Distribution of establishments by activity.

CNAE code	CNAE description	No. obs.	% of total
10	Manufacture of food products	398	12.49
12	Manufacture of tobacco products	6	0.19
13	Manufacture of textile products	65	2.04
14	Production of apparel items and accessories	346	10.86
15	Treatment of leather, and manufacture of leather items and footwear	605	18.98
16	Manufacture of wood products	216	6.78
17	Manufacture of pulp, paper and paper products	42	1.32
18	Printing and image reproduction	115	3.61
19	Manufacture of coke, oil products and biofuels	7	0.22
20	Manufacture of chemical products	68	2.13
21	Manufacture of drugs and pharmaceutical products	10	0.31
22	Manufacture of rubber and plastic products	125	3.92
23	Manufacture of non-metallic mineral products	148	4.64
24	Metallurgy	52	1.63
25	Manufacture of metal products other than machinery and equipment	424	13.30
26	Manufacture of IT, electronic and optical equipment	31	0.97
27	Manufacture of electrical machines, devices and materials	44	1.38
28	Manufacture of machines and equipment	17	0.53
29	Manufacture of automotive vehicles, trailers and bodywork	44	1.38
30	Manufacture of transport equipment other than vehicles	7	0.22
31	Manufacture of furniture	240	7.53
32	Manufacture of various products	127	3.98
33	Maintenance, repair and installation of machines and equipment	50	1.57
–	Total	3187	100

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.

Table 4
Companies adopting and not adopting the Regime: averages for selected variables.

Year	*formal_emps*		*avge_salary*		*time_empl*	
	Adopt	Non-adopt	Adopt	Non-adopt	Adopt	Non-adopt
2007	3.50	4.90	595.00	717.00	12.30	25.70
2008	4.00	5.00	698.00	848.00	17.70	31.30
2009	4.20	5.00	743.00	942.00	22.60	35.40
2010	4.70	5.30	832.00	1038.00	26.40	38.80
2011	4.90	5.60	919.00	1159.00	30.40	43.10
2012	4.90	6.00	1044.00	1332.00	35.00	43.60
2013	5.10	6.10	1183.00	1502.00	38.20	46.70
Δ%	45.71	24.49	98.82	109.48	210.57	81.71

Source: RAIS, 2007–2013 (Microdata). Compilation: Author. *'Adopt'* = Establishments adopting the Simplified Tax Regime; *'Non-adopt'* = Establishments not adopting.
Note: The variables used in the table are the same described in Table 1.

Delgado et al. (2007) had found a contrary indication: that companies not opting for the Regime had better performance in terms of average employment, but that analysis considered only activities in the services sector. Thus there is an apparent variation of results, in terms of the effect of the program, in different sectors of the economy.

5.2. Survival Analysis

The first result of the Survival Analysis of the manufacturing establishments studied over the period 2007–2013 is shown in Table 5. A key point that stands out is the high 'mortality' of the establishments in their first two years of activity. Of the initial total of 3187, only 57% survived the first two years. At the end of the sixth year (2013), only

Table 5
Survival data table.

Interval		N° of establishments active at start of each year	'Deaths'	Survival rate	Standard error	[95% Conf. Int.]	
2007	2008	3187	909	0.715	0.008	0.699	0.730
2008	2009	2278	463	0.570	0.009	0.552	0.587
2009	2010	1815	289	0.479	0.009	0.461	0.496
2010	2011	1526	214	0.412	0.009	0.395	0.429
2011	2012	1312	146	0.366	0.009	0.349	0.383
2012	2013	1166	156	0.317	0.008	0.301	0.333
2013	–	1010	0	0.317	0.008	0.301	0.333

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.
'Deaths' = Number of establishments that left the sample each year.
Losses = Number of establishments that could no longer be accompanied in the study; right-censored observations.
Survival rate = Survival Rate or Survival Function.

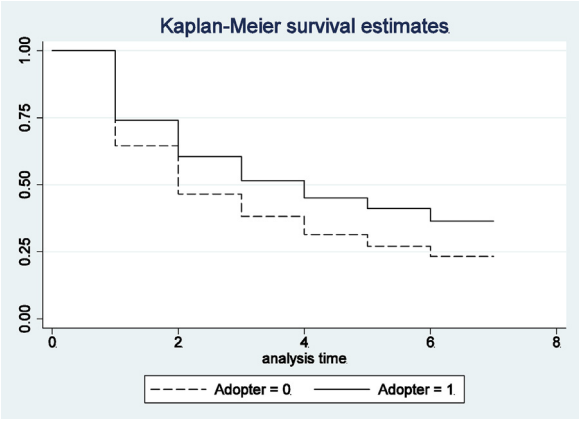

Fig. 1. Survival function of establishments: adopters versus non-adopters.
Source: RAIS, 2007–2013 (Microdata). Compilation: Author. Note: Adopter is the dummy variable described in Table 1.

31.7% of the establishments were active. This result is similar to the one found by Resende et al. (2016) of 50% of survival rate three years after firm is born. Coelho et al. (2017) found that the highest death risk rate for an emerging company occurs in the second year of activities. These pieces of evidence support the perception that there is a high turnover of creation and closures of establishments in the Brazilian economy each year (Najberg et al., 2000; IBGE, 2013).

It needs to be pointed out that – in spite of the high levels of early 'death' of the establishments – the manufacturing industry is traditionally one of the most long-lived sectors of the economy, due especially to the higher entry and exit barriers inherent to the sector (technical knowledge, requirement for capital and degree of market concentration), as already highlighted in the literature review.

Fig. 1 shows that the establishments that opted for the Simplified Regime had higher levels of survival than those that did not. It gives the survival function for each group, versus the number of years elapsed.

It is interesting to note that both groups follow the same trend of 'mortality', although there is a difference in longevity between them as early as the second year. This common tendency of 'mortality' between those adopting and those not adopting the Regime appears to be sustained even when one observes the establishments by their different levels of technology intensiveness.

Fig. 2 shows the survival function for those adopting and those not adopting the Regime as a function of years elapsed in the various technology intensiveness groups: Low, Medium-Low, Medium-High and High. Traditionally, the various segments of manufacturing industry behave differently in economic variables such as physical production, volume of exports and generation of employment (Manufacturing Development Studies Institute, 2016).

The Log-rank test confirms this result in relation to a positive effect of the Simplified Regime on establishments' survival (Table 6). In the segments of Low and Medium-Low technological intensiveness there is statistically significant

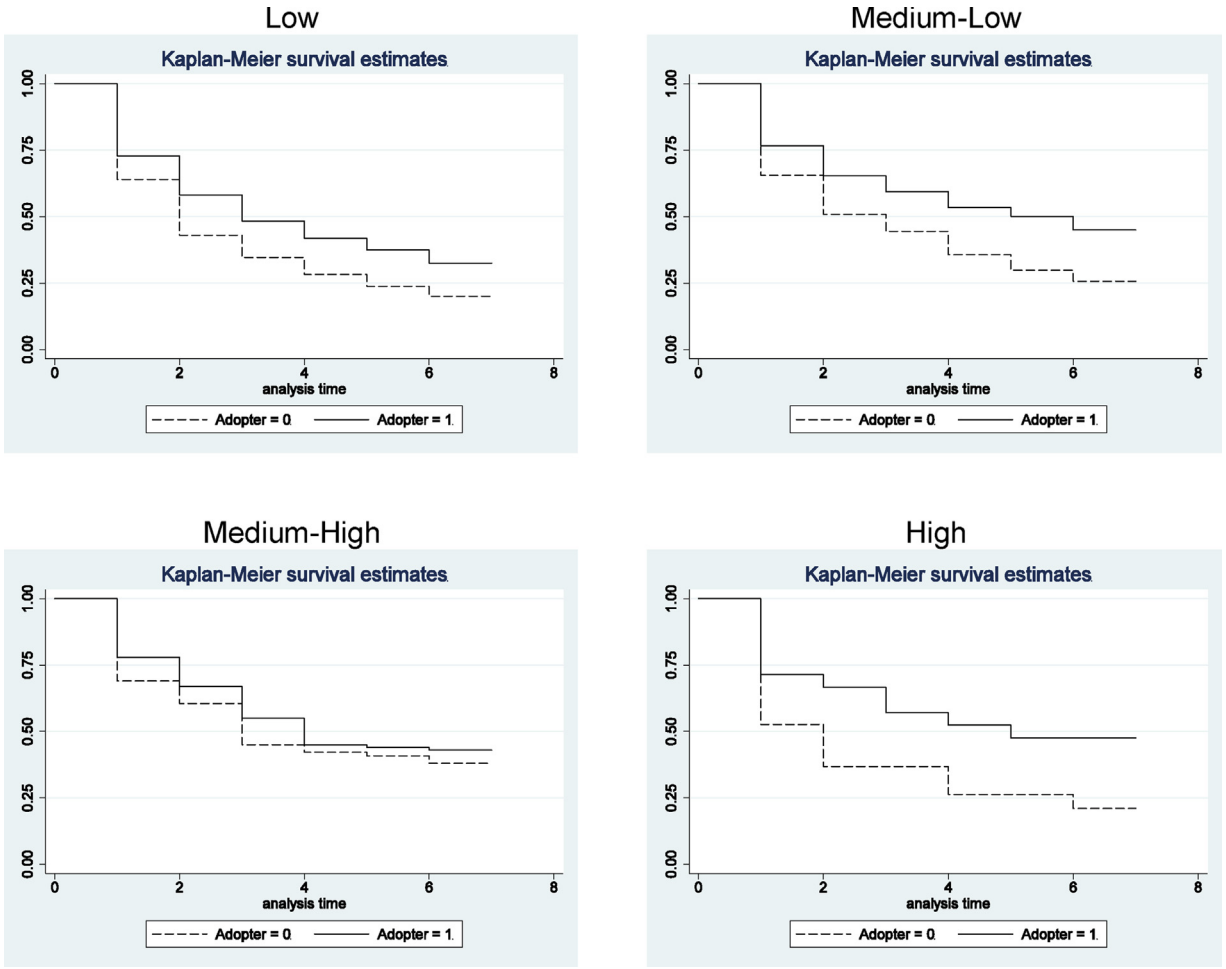

Fig. 2. Survival function of establishments, by status as to the Simplified Regime and level of technology intensiveness.
Source: RAIS, 2007–2013 (Microdata). Compilation: Author. Note: Adopter is the dummy variable described in Table 1.

Table 6
Log-rank test.

Adopter of Regime	Total		Low		Medium-Low		Medium-High		High	
	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.
No	658	516.36	438	346.23	154	109.94	51	45.82	15	11.43
Yes	1519	1660.64	1101	1192.77	345	389.06	61	66.18	12	15.57
Total	2177	2177	1539	1539	499	499	112	112	27	27
Chi-squared (1)	65.49		41.07		28.14		1.23		2.65	
Pr > chi-squared	0.0000		0.0000		0.0000		0.2675		0.1037	

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.
Note: Obs. = observed events; Exp. = expected events.

difference in the degree of survival between those adopting and those not adopting the Regime, which is not repeated in comparison between the Medium-High and High groups.

Table 6 shows both the estimated effects of the co-variates and of the variable 'Adopter', on the risk function of the establishments for the whole of the sample and also for subgroups. The coefficients are interpreted as risk hazard

Table 7
Cox Regression.

	Total		Low		Medium-Low		Medium-High		High	
	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|
Low	1 (omitted)		–		–		–		–	
Medium-Low	**0.831**	0.000	–		–		–		–	
Medium-High	**0.799**	0.024	–		–		–		–	
High	0.938	0.746	–		–		–		–	
Adopter	**0.710**	0.000	**0.736**	0.000	**0.614**	0.000	0.888	0.582	0.655	0.311
formal_emps	0.818	0.084	0.774	0.063	1.115	0.619	0.316	0.121	0.487	0.576
contr_hrs	1.004	0.092	1.005	0.059	0.997	0.602	1.025	0.132	1.013	0.640
avg_salary	**0.999**	0.001	0.999	0.061	**0.999**	0.047	0.999	0.255	0.998	0.081
time_empl	**1.002**	0.002	**1.002**	0.011	**1.003**	0.033	1.005	0.145	0.983	0.233
total_sals	1.000	0.606	0.999	0.822	1.000	0.902	1.000	0.314	**1.000**	0.039
Log likelihood	−16,748.53		−11,212.46		−3172.66		−547.85		−88.79	
LR chi-squared	101.51		45.84		32.53		7.62		7.80	
Prob > chi-squared	0.0000		0.0000		0.0000		0.2676		0.2530	

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.
Note: Significance 5% — in bold type. HR (*hazard ratios*).

ratios, i.e. if the coefficient is less than one, there is a reduction in the risk of mortality — while hazard ratios greater than one suggest an increase of risk of an occurrence of the event.

The coefficients associated with the dummy variables for the technological levels (reference category: Low) show that the higher the technology intensiveness, the lower the establishment's risk of mortality. A possible explanation could be associated with the higher levels of productivity, probability of exporting and investment on R&D of the segments with higher technology intensiveness, as shown by De Negri et al. (2014). This evidence appears to indicate that the fiscal incentive represented by the Simplified System is more determinant for the survival of companies with Low and Medium-Low technology intensiveness.

This is above all a new result in the literature on the Simplified Tax Regime and on Brazilian manufacturing industry. Furthermore, it is a result that corroborates the hypothesis of Carvalho and Cerqueira (2010) on the differences in the degree of survival by economic activity — showing different effects of the regime for different levels of technology intensiveness (in the sectors of manufacturing industry that are eligible for the Regime).

In terms of public policies, the detailing of the beneficiaries groups into sectors of Low, Medium-Low, Medium-High and High technology intensiveness makes it possible to provide a better focus for the program. In the legislative debate on expansion of the Simplified Regime, these evidences could suggest that the program is effective as a policy in support of the longevity of small business, although at the same time it does not enable any inference to be drawn on its relationship with costs and benefits. We should note, on other hand, that the literature has found that high technology sectors are more likely to survive and it may affect our results on the effect of the Simplified Regime on this sectors particularly.

In relation to the other covariates, only average salary (*avge_salary*) and the time of duration of employment relationships (*time_empl*) had 5% significance. The variable for the number of employees (*formal_emps*) was not shown to be significant for explaining survival of the establishments, which is an interesting result, since what is considered are establishments with up to 19 employees.

The variation in *number of employment relationships* between companies with up to 19 employees and those with more than 500 is important. In micro-establishments, size does not appear to be determinant for mortality. The variables for total of hours contracted (contr_hrs) and total salaries (total_sals) serve only as controls in the regression.

The main result of the model is the estimate of the Simplified Regime effect on the risk of closure. As Table 7 shows, the choice of the Simplified Regime appears to reduce the establishment's chances of mortality by 30% — for constant number of employees, average salary, turnover and level of technology intensiveness of the sector.

Table 8 shows the result of the Schoenfeld test for the hypothesis of proportional risks assumed by the Cox regression model. The null hypothesis is proportionality of the risks between the individuals, which was not rejected at 5%

Table 8
Schoenfeld test for the hypothesis of proportional risks in the Cox regression.

	chi-squared	df	Prob > chi-squared
Global test	8.41	6	0.2097

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.

significance (Prob > $chi^2 = 0.207$). With this, the main requirement for use of the Cox model was fulfilled, giving validity to the regression's findings.

In order to check the robustness of the results, Table A2 presents the results of the Cox regression for establishments born in 2008, considering the same specification proposed for those born in 2007. As can be seen, the coefficient associated with the 'Adopter' variable indicates that establishments opting for Simples have a 38% lower chance of mortality than the ones not opting in. Table A3 shows the Schoenfeld test, which confirms the Cox regression's validity. In this sense, the evidence suggests that the result found in the main analysis is not confined to only one cohort born in a specific year.

A second verification is done by performing the analysis for the companies that were excluded from the final sample because they have changed of status as to Simplified Regime over the period. Table A4 shows that the evolution of variables related to number of workers, average salary and length of employment among the companies excluded from the sample is similar to those that remained in the sample. Along similar lines, Table A5 indicates that, from the sectoral point of view, there are no major changes in the distribution of companies between the different activities, with emphasis only on a greater concentration in the food manufacturing sector (CNAE code 10) and in the metallurgical sector (CNAE code 24).

Fig. A1 presents the Kaplan–Meier for optants of the Simplified Regime, considering establishments that are in the final sample versus those that were excluded from the sample. The results indicate that the companies that were excluded from the base have a higher survival rate than the establishments in the final sample. Table A6 shows that the difference between the survival curves of the two groups is statistically significant. Thus, the proposed strategy does not seem to have harmed the analysis of the effects of Simples.

In the previous section it was possible to observe that the growth in average time of employment and volume of employment was greater for the establishments that chose the Simplified Regime. A possible explanation would be associated with the results of this section, in that the lower mortality of those adopting the system could have enabled an increase in the stability of the existing employment relationships and creation of new jobs at a higher rate than in those not adopting the Regime.

6. Conclusion

This paper has aimed to evaluate the effects of the Brazilian Simplified Tax Regime on the longevity of manufacturing micro-establishments. We used a sample of more than 3000 establishments that were created in 2007 in manufacturing sectors eligible to the Regime with up to 19 employees and tax domicile in the Brazilian State of Rio Grande do Sul. The information used comes from the micro-data of RAIS for the period from 2007 to 2013.

The first stage of the analysis consisted of obtaining a sample with two groups of establishments with similarities in their economic structure at the initial moment of the investigation through Propensity Score Matching. The first group comprised establishments that were created in the first year in which the National Simplified Regime was in effect and that opted for the Regime. The second was those that were also created in 2007 but did not choose the Regime and remained not choosing it.

As to the profile of these establishments, it is noteworthy that the large majority of them opted for the Regime (73.40%), with predominance in the activities of manufacture of food products, production of apparel items, production of leather/footwear and manufacture of metal products. According to the classification by technological intensity, such activities are not very intensive in technology (Low and Medium-Low).

The establishments that adopted the Regime showed faster growth in comparison to those that did not adopt it, in three out of the four compared variables. These variables are: the number of employees with formal employment contract, the duration of employment relationships and total salaries. This is an important indication of the role played by the

Regime in preservation of Brazilian manufacturing micro-companies, becoming evidence in favor of the Simplified Regime.

Survival Analysis showed a high mortality of establishments in the first years of activity, this being a stylized fact of the demography of firms in Brazil even in the most long-lived economy sector. We draw attention to the shortage of studies on mortality of companies in the country, in spite of the importance of these results. Once again, the comparison between those opting for the Regime and those not opting for it showed a statistically significant difference in the pattern of longevity between the two groups. The Cox regression made it possible to identify that establishments adopting the Regime had a 30% lower chance of mortality than those not adopting it, even when the effects of size, average wage and average duration of employment link are controlled. This result is very important in the debate about the impacts of the Simplified Regime on the Brazilian economy, because it reveals a facet of the effects of the program that is still little explored by the literature.

The second important finding is related to confirmation of the initial hypothesis: (i) manufacturing establishments with Low and Medium-Low technology intensiveness that choose the Simplified Regime have lower probabilities of extinction than those that do not choose the Regime and (ii) this is not repeated among manufacturing sectors with Medium-High and High technology intensiveness. These results remained throughout the robustness tests. This suggests that the tax incentive represented by the National Simplified Regime appears to be more important for the survival of the less technology-intensive sectors.

In relation to the legislative debate on expansion of the program, it can be pointed out that: if, on the one hand, the Simplified Regime is expensive and symbolizes a greater tax sacrifice by the federal government, on the other hand, the evidence of this paper indicates a possible contribution of the Simplified Regime to reduction of companies' mortality and increase of employment in the establishments that do adopt it.

Appendix A.

See Fig. A1, Tables A1–A6.

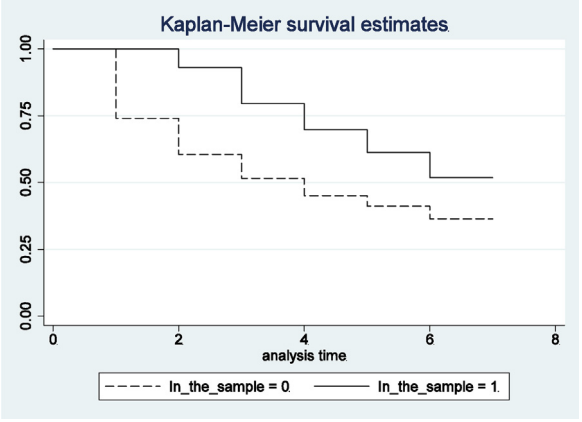

Fig. A1. Survival function of adopter establishments of the Simplified Regime: firms in the original sample versus those that are out of the original sample (firms created in 2007).
Source: RAIS, 2007–2013 (Microdata). Compilation: Author. Note: 'In_the_sample' is a variable that indicates whether the establishments, adopters of the Simplified Regime, are in the original sample or not.

Table A1
Classification of manufacturing activities.

CNAE code	CNAE description	Classification
101	Slaughter and production of meat products	Low
102	Preservation of fish and fish breeding	Low
103	Canning of fruits, vegetables and other	Low
104	Manufacture of vegetable and animal oils and fats	Low
105	Dairy products	Low
106	Grinding, starches and animal feed	Low
107	Manufacture and refining of sugar	Low
108	Roasting and grinding of coffee	Low
109	Manufacture of other food products	Low
111	Production of alcoholic beverages	Low
112	Production of non-alcoholic beverages	Low
121	Industrial processing of tobacco	Low
122	Manufacture of tobacco products	Low
131	Preparation and spinning of textile fibers	Low
132	Weaving, except knitted and crocheted fabrics	Low
133	Manufacture of knitted and crocheted fabrics	Low
134	Textile yarns, fabrics and artifacts	Low
135	Manufacture of textile articles, except clothing	Low
141	Manufacture of clothing items and accessories	Low
142	Manufacture of knitted and crocheted items	Low
151	Tanning and other leather preparations	Low
152	Manufacture of traveling and other leather goods	Low
153	Manufacture of footwear	Low
154	Manufacture of footwear parts	Low
161	Wood splitting	Low
162	Manufacture of wood, cork and braided products	Low
171	Manufacture of paper and paperboard	Low
172	Manufacture of paper, cardboard paper and cardstock paper	Low
173	Manufacture of paper packaging and others	Low
174	Manufacture of various paper products	Low
181	Printing activity	Low
182	Prepress services and graphic finishing	Low
183	Playback of recorded material	Medium-Low
191	Coke ovens	Medium-Low
192	Manufacture of petroleum products	Medium-Low
193	Production of biofuels	Medium-Low
201	Manufacture of inorganic chemicals	Medium-High
202	Manufacture of organic chemicals	Medium-High
203	Manufacture of resins and elastomers	Medium-High
204	Manufacture of artificial and synthetic fibers	Medium-High
205	Manufacture of argicultural pesticides and disinfectants	Medium-High
206	Manufacture of cleaning products, toiletries and others	Medium-High
207	Manufacture of paints, varnishes and the like	Medium-High
209	Manufacture of other chemical products	Medium-High
211	Manufacture of pharmaceutical chemicals	High
212	Manufacture of pharmaceutical products	High
221	Manufacture of rubber products	Medium-Low
222	Manufacture of plastic products	Medium-Low
231	Manufacture of glass and glass products	Medium-Low
232	Manufacture of cement	Medium-Low
233	Manufacture of concrete products and the like	Medium-Low
234	Manufacture of ceramic products	Medium-Low
239	Stones and non-metallic minerals treatment	Medium-Low
241	Manufacture of pig-iron and ferroalloys	Medium-Low
242	Steel mill	Medium-Low
243	Manufacture of steel pipes, except seamless pipes	Medium-Low
244	Metallurgy of non-ferrous metals	Medium-Low

Table A1 (*Continued*)

CNAE code	CNAE description	Classification
245	Foundry	Medium-Low
251	Manufacture of metal structures and boilers	Medium-Low
252	Manufacture of metal tanks and the like	Medium-Low
253	Forging, stamping, powder metallurgy and the like	Medium-Low
254	Manufacture of cutlery, metal work tools and the like	Medium-Low
255	Manufacture of heavy military equipment and the like	Medium-Low
259	Manufacture of metal products (others)	Medium-Low
261	Manufacture of electronic components	High
262	Manufacture of computer and peripheral equipment	High
263	Manufacture of communication equipment	High
264	Manufacture of receptors and the like and audio/video	High
265	Manufacture of measuring, testing and control apparatus	High
266	Manufacture of electromedical equipment and the like	High
267	Manufacture of optical, photographic and similar equipment	High
268	Manufacture of blank, magnetic and optical media	High
271	Manufacture of generators, converters and the like	Medium-High
272	Manufacture of batteries and the like	Medium-High
273	Manufacture of electric power equipment	Medium-High
274	Manufacture of lamps and the like	Medium-High
275	Manufacture of household appliances	Medium-High
279	Manufacture of electrical equipment (others)	Medium-High
281	Manufacture of engines, pumps, compressors and other	Medium-High
282	Manufacture of machinery and equipment for general use	Medium-High
283	Manufacture of tractors and agricultural and cattle breeding equipment	Medium-High
284	Manufacture of machine tools	Medium-High
285	Manufacture of machinery for mining, quarrying and construction	Medium-High
286	Manufacture of industrial machinery and equipment	Medium-High
291	Manufacture of cars, pickup trucks and SUV's	Medium-High
292	Fabricação de caminhões e ônibus	Medium-High
293	Manufacture of cabs, truck bodies and tow trucks	Medium-High
294	Manufacture of parts and accessories for motor vehicles	Medium-High
295	Recovery of vehicles	Medium-High
301	Boat building	Medium-Low
303	Manufacture of railway vehicles	Medium-High
304	Manufacture of aircraft	High
305	Manufacture of military fighting vehicles	Medium-High
309	Manufacture of transport equipment (others)	Medium-High
310	Manufacture of furniture	Low
321	Manufacture of jewelry, custom jewelry and the like	Low
322	Manufacture of musical instruments	Low
323	Manufacture of fishing and sports equipment	Low
324	Manufacture of toys and recreational games	Low
325	Manufacture of instruments and materials for medical use	Medium-High
329	Manufacture of other products	Low
331	Maintenance and repair of machinery and equipment	Medium-Low
332	Installation of machinery and equipment	Medium-Low

Source: adapted from Cavalcante (2014).

Table A2
Cox Regression for firms created in 2008.

	Total		Low		Low-Medium		Medium-High		High	
	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|	HR (hazard ratio)	P>|z|
Low	1 (omitted)		–		–		–		–	
Medium-Low	**0.876**	0.016	–		–		–		–	
Medium-High	0.852	0.115	–		–		–		–	
High	0.923	0.694	–		–		–		–	
Adopter	**0.613**	0.000	**0.638**	0.000	**0.491**	0.000	0.784	0.254	0.767	0.526
formal_emps	0.937	0.511	0.836	0.189	1.110	0.444	1.020	0.970	1.250	0.781
contr_hrs	1.001	0.634	1.003	0.219	0.997	0.362	0.998	0.876	0.989	0.581
avg_salary	**0.999**	0.005	**0.999**	0.005	0.999	0.187	0.999	0.800	**0.997**	0.005
time_empl	1.001	0.156	1.001	0.228	1.000	0.779	1.002	0.487	1.006	0.498
total_sals	**1.000**	0.038	1.000	0.195	1.000	0.780	1.000	0.278	**1.000**	0.007
Log likelihood	−14,525.764		−9431.495		−2903.8087		−531.33241		−79.915812	
LR chi-squared	98.15		56.80		41.84		7.03		12.18	
Prob>chi-squared	0.0000		0.0000		0.0000		0.3178		0.0582	

Source: RAIS, 2008–2013 (Microdata). Compilation: Author.
Note: Significance 5% — in bold type. HR (*hazard ratios*).

Table A3
Schoenfeld test for the hypothesis of proportional risks in the Cox regression for firms created in 2008.

	chi-squared	df	Prob > chi-squared
Global test	14.33	9	0.1112

Source: RAIS, 2008–2013 (Microdata). Compilation: Author.

Table A4
Companies adopting and not adopting the Regime: averages for selected variables for firms out the original sample (firms created in 2007).

Year	formal_emps		avge_salary		time_empl	
	Adopt	Non- adopt	Adopt	Non-adopt	Adopt	Non-adopt
2007	4.68	4.90	692.00	660.00	16.12	22.43
2008	5.33	5.45	743.00	764.00	21.37	24.50
2009	5.36	5.38	823.00	847.00	24.59	30.59
2010	5.63	5.77	890.00	977.00	28.00	35.26
2011	5.88	4.82	10,479.00	1126.00	34.17	41.80
2012	5.36	5.07	1119.00	1067.00	36.74	47.76
2013	5.43	5.59	1185.00	1263.00	40.61	52.30
Δ%	16.03	14.08	71.24	91.36	151.92	133.17

Source: RAIS, 2007–2013 (Microdata). Compilation: Author. 'Adopt' = Establishments adopting the Simplified Tax Regime; 'Non-adopt' = Establishments not adopting.
Note: The variables used in the table are the same described in Table 1.

Table A5
Distribution of the establishments by activity for firms out the original sample (firms created in 2007).

CNAE code	CNAE description	N° obs.	% of total
10	Manufacture of food products	25	6.70
12	Manufacture of tobacco products	1	0.27
13	Manufacture of textile products	12	3.22
14	Production of apparel items and accessories	28	7.51
15	Treatment of leather, and manufacture of leather items and footwear	55	14.75
16	Manufacture of wood products	29	7.77
17	Manufacture of pulp, paper and paper products	7	1.88
18	Printing and image reproduction	17	4.56
19	Manufacture of coke, oil products and biofuels	–	–
20	Manufacture of chemical products	10	2.68
21	Manufacture of drugs and pharmaceutical products	–	–
22	Manufacture of rubber and plastic products	26	6.97
23	Manufacture of non-metallic mineral products	14	3.75
24	Metallurgy	7	1.88
25	Manufacture of metal products other than machinery and equipment	77	20.64
26	Manufacture of IT, electronic and optical equipment	2	0.54
27	Manufacture of electrical machines, devices and materials	4	1.07
28	Manufacture of machines and equipment	3	0.80
29	Manufacture of automotive vehicles, trailers and bodywork	12	3.22
30	Manufacture of transport equipment other than vehicles	–	–
31	Manufacture of furniture	29	7.77
32	Manufacture of various products	11	2.95
33	Maintenance, repair and installation of machines and equipment	4	1.07
–	Total	373	100

Source: RAIS, 2007–2013 (Microdata). Compilation: Author.

Table A6
Log-rank test for firms in and out the original sample (firms created in 2007).

Adopter of Regime	Total	
	Observed	Expected
No	1904	1787.79
Yes	158	274.21
Total	2062	2062
Chi-squared (1)	69.88	
Pr > chi-squared	0.0000	

Source: RAIS, 2008–2013 (Microdata). Compilation: Author.

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